

CLAIMS

1. A photomask blank comprising a thin film having at least a shading function (light-shielding function, opaque function, non-transmitting function) formed over a transparent substrate,

wherein the thin film contains helium.

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2. A photomask blank comprising a thin film having at least a shading function (light-shielding function, opaque function, non-transmitting function) formed over a transparent substrate,

wherein the thin film is formed by sputtering in which a sputtering target is disposed in a vacuum chamber into which an atmosphere gas has been introduced, and the thin film is formed at a deposition rate of 0.5 nm/sec to 6 nm/sec, and the helium gas content is 30 to 90 vol% in the atmosphere gas.

20 3. The photomask blank according to Claim 1 or 2,
wherein the thin film contains at least one of carbon or oxygen.

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4. The photomask blank according to Claim 3, wherein
the thin film is a laminated film including a shading film
(light-shielding film, opaque film, non-transmitting film)
that contains carbon, and an anti-reflective film that
5 contains oxygen.

5. The photomask blank according to Claim 4, wherein
the thin film has an oxygen content that continuously
decreases and a carbon content that continuously increases
10 from the thin film surface side to the transparent substrate
side.

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6. The photomask blank according to Claim 4 or 5,
wherein the carbon content is 0 to 25 at% and the oxygen
15 content is 0 to 70 at%.

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7. The photomask blank according to any of Claims 1
to 6, wherein the thin film further contains nitrogen.

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20 8. The photomask blank according to any of Claims 1
to 7, wherein the thin film has a crystal grain size of 1 to
7 nm.

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9. The photomask blank according to any of Claims 1
to 8, wherein a nitride film containing nitrogen and the
same metal material contained in the thin film is formed
between the transparent substrate and the thin film.

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10. The photomask blank according to any of Claims 1
to 9, wherein the thin film has an oxygen content that
continuously decreases and a carbon content that
continuously increases from the thin film surface side to

10 the transparent substrate side, nitrogen is contained in the
nitride film in a relatively greater amount than the amount
of nitrogen contained in the thin film, and the amount of
the metal decreases as the amount of nitrogen in the nitride
film increases.

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11. The photomask blank according to any of Claims 1
to 10, wherein the thin film contains chromium.

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12. The photomask blank according to any of Claims 1
to 11, wherein the transparent substrate is composed of
quartz glass.

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13. A photomask on which a mask pattern has been
formed by the patterning of the thin film formed on the

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transparent substrate of the photomask blank pertaining to
the invention in ~~any of~~ Claims 1 to 12, or of the thin film
and the nitride film.

5 14. A method of manufacturing a photomask blank, in
which a sputtering target is disposed in a vacuum chamber
into which an atmosphere gas has been introduced, and at
least a thin film having a shading function (light-shielding
function, opaque function, non-transmitting function) is
10 formed over a transparent substrate by sputtering,

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wherein the correlation between the amount of helium
gas contained in the atmosphere gas and the film stress of
the thin film is determined ahead of time,

15 the helium gas content is determined from said
correlation so that the thin film will have a film stress
such that the mask pattern obtained when the thin film is
patterned will have the desired pattern position precision,
and the thin film is formed by sputtering in an atmosphere
gas having this helium gas content.

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15. A method of manufacturing a photomask blank, in
which a sputtering target is disposed in a vacuum chamber
into which an atmosphere gas has been introduced, and at
least a thin film having a shading function (light-shielding

function, opaque function, non-transmitting function) is formed over a transparent substrate by sputtering.

wherein the thin film is formed at a deposition rate of 0.5 nm/sec to 6 nm/sec, and

the atmosphere gas contains helium gas.

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16. A method of manufacturing a photomask blank, in which a sputtering target is disposed in a vacuum chamber into which an atmosphere gas has been introduced, and at least a thin film having a shading function (light-shielding function, opaque function, non-transmitting function) is formed over a transparent substrate by sputtering,

wherein the thin film is formed at a sputtering power of 950 to 3000 W, and

15 the atmosphere gas contains helium gas.

17. The method of manufacturing a photomask blank according to any of Claims 14 to 16, wherein the helium gas content is 30 to 90 vol% in the atmosphere gas.

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18. The method of manufacturing a photomask blank according to any of Claims 14 to 17, wherein the helium gas content is 40 to 65 vol% in the atmosphere gas.

19. The method of manufacturing a photomask blank according to any of Claims 14 to 18, wherein the thin film contains at least one of carbon or oxygen.

5 20. The method of manufacturing a photomask blank according to Claim 19, wherein the thin film is a laminated film including a shading film (light-shielding film, opaque film, non-transmitting film) that contains carbon, and an anti-reflective film, that contains oxygen, and at least one 10 of the shading film (light-shielding film, opaque film, non-transmitting film) or the anti-reflective film is formed by sputtering in an atmosphere gas containing helium gas.

15 21. The method of manufacturing a photomask blank according to any of Claims 14 to 20, wherein a nitride film containing nitrogen and the same metal contained in the thin film is formed between the transparent substrate and the thin film.

20 22. The method of manufacturing a photomask blank according to any of Claims 14 to 21, wherein the thin film, or the thin film and the nitride film, is or are formed by inline sputtering.

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23. The method of manufacturing a photomask blank
according to any of Claims 14 to 22, wherein the thin film
contains chromium.

A 5 24. The method of manufacturing a photomask blank
according to any of Claims 14 to 23, wherein the transparent
substrate is composed of quartz glass.

A 10 25. A method of manufacturing a photomask, wherein a
mask pattern is formed by selectively removing the film
formed on the transparent substrate of a photomask blank
obtained by the manufacturing method pertaining to the
invention in any of Claims 14 to 24.

A 15 26. A method of forming a micropattern, in which a
fine pattern is formed over a substrate by photolitho-graphy,
wherein the photomask according to Claim 13 is used as
the mask used in transferring the fine pattern.

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